Chapter III

RIVER AND HARBOR IMPROVEMENT

For a half-century after Independence, river and harbor improvement remained a local responsibility. Federal activity, of any significance, began in the 1820s, motivated by the same economic and military considerations that led to the General Survey Act of 1824 relating to roads and canals. But just as the intention of that measure was frustrated within a decade and a half, so was the program of navigation improvement. Occasional federal projects continued to be carried out, but it was not until after the Civil War, when a new economic, technological, and political climate prevailed in the nation, that the federal government initiated a vigorous and continuing program of river and harbor improvements.

EARLY LOCAL EFFORTS ON RIVERS

As shallow sloops and often larger vessels generally had little difficulty navigating the tidal reaches of rivers, state agencies and private companies directed their attention mostly toward improving small boat navigation on upstream stretches. They made some rivers considerably more usable, but more often their success was limited.

On the Merrimack River the series of canals constructed by subsidiaries of the Middlesex Canal Company provided a workable system of navigation. All the locks were large enough to pass the 75-foot boats employed on the canal. Towed along that ditch by horse or oxen, and propelled on the river by oars, poles, and under favorable conditions by sail, the boats could travel uninterrupted to Concord.

In 1812 steamboats, used for the first time as tugs on an American waterway, began towing barges on the canal and river. But they proved of little advantage. At speeds greater than three-and-a-half miles an hour on the canal they badly washed its banks, and whatever time they saved was usually more than offset by delays at the locks. On the river, traffic was not sufficiently regular, nor were the reaches between the canals sufficiently long, to use tugs profitably. Towing by steam was abandoned in 1820 and never resumed.[1]

Navigation on the Connecticut River above the head of sloop navigation at Hartford, while much improved by canals, was less satisfactory. Flatboats carrying 15 to 18 tons of cargo could use the river during high water in spring and fall, but during the summer months navigation was restricted to lighter boats with draft of only 12 to 15 inches. Other conditions were even

more disadvantageous. Although flatboats operated with some regularity between Hartford and the Massachusetts towns upriver, and for a time small steamboats towed barges on stretches of the river, inhabitants of the upper valley often found it cheaper to send wagons overland to Boston, to Portland, or to Lake Champlain, from where products could be sent down the Champlain Canal to the Hudson River. As separate companies operated the canals, tolls were not uniform and locks varied in size. Boats that could pass the locks in the lower river could not squeeze through those in Vermont. Nor was there satisfactory slack-water navigation, as the dam of one company did not back water to the foot of the next. At ten places on the upper river the help of extra men or oxen, and sometimes the toilsome expedient of lightening the cargo, was required to get boats through rapids.

Below Hartford the major obstacles to navigation were river bars scattered downstream from the city for about ten miles. The Connecticut at this point flows through an alluvial region and its banks are easily eroded, causing constant changes of its bed and the formation of shoals at every flood stage. In 1800 the Connecticut legislature entrusted improvement to the Union Company, which, like the canal companies, could recover its expenditures by collecting tolls. Dredging sandbars, reveting banks with stone and planting them with willows, and extending wing dams into the river to scour shoals by concentrated currents, the company secured a channel of seven-and-a-half feet over the bars. The toll system, which opponents said should not be applied on "navigable tide waters*' of the state, aroused intermittent hostility throughout the six decades of the company's chartered life. But the improvements enabled larger vessels to reach Hartford and relieved all trade of many interruptions, especially in periods of low water.[2]

In Pennsylvania the major efforts to improve river navigation were the Schuylkill Canal and slackwater system, discussed in the previous chapter, and works on the Lehigh River. Beginning in 1791 the state legislature enacted provisions for improving the Lehigh, but little was accomplished until 1818, when Pennsylvania allowed the Lehigh Coal Mine Company to take measures to move coal down the river to market. In some places the company scoured out shoals with wing dams, and in others it made rapids navigable by the unique device of "artificial freshets." This consisted of constructing V-shaped dams across the river at the heads of rapids, thus forming pools above them. Sluice gates opened in the dams created artificial floods that floated coal-carrying arks over the rapids. The arks were merely large boxes 16 to 18 feet wide and 20 to 25 feet long, steered with oars like a raft. For economy of operation two arks were joined together, fastened by hinges to allow them to bend up and down in passing

over rapids. As men became accustomed to handling the arks and the channel of the river was improved, more sections were added until their whole length reached 180 feet. From the mouth of the Lehigh the arks floated down the Delaware River to Philadelphia. There they were broken up for lumber, as the system of artificial freshets did not permit upstream navigation. It was this disadvantage, combined with rapidly increasing business, that soon led to the construction of the Lehigh Canal. On the Delaware River, the state carried out minor improvements. In 1817 it spent $10,000 to improve navigation from Trenton to Foul Rift, 12 miles above Easton, most of the money being used to blast rocks and build wing dams at Rocky Falls and Wells Falls. Two years later the state constructed wing dams at Scudders Falls.[3]

The southern states, with their plentiful, lengthy, but shallow rivers, saw the greatest efforts at improvement. The James River Company that set out in 1785 to create a trans-Appalachian transportation system was essentially a river improvement concern, and during its half-century of existence it not only built two canals but cleared obstructions from the river and constructed wing dams and sluices. Sluicing consisted of cutting channels through shoals, confining them by stone walls on each side, and directing stream flow through them with wing dams at their approaches. The company also improved navigation on the Rivianna, Willis, and North river branches of the James. But its operations were so limited and ineffective that inhabitants along the James persistently complained. In dry seasons the river was not everywhere navigable by boats drawing a mere foot of water, as required by the company's charter.[4]

The Potomac Canal Company, which also began operations in 1785, was, like the James River Company, primarily intent on river improvement, and it undertook canal construction only at falls. The canals, however, absorbed so much of its limited resources that it made only minor excavations in the main river and its larger branches. In the upper course of the Potomac it never attained more than a foot of permanent water. Thus it failed to achieve its modest charter objective, which was to provide a safe channel in all seasons for vessels carrying 50 barrels of flours

The state of Virginia, which controlled the James River Company after 1820, also financed other river improvements. In 1816 the legislature created a Fund for Internal Improvement, to be administered by a Board of Public Works. The system remained in effect until the Civil War, by which time the state held an interest in 12 canal and navigation projects, several still unfinished, as well as in roads, bridges, and railroads.[6]

North Carolina enacted river improvement measures as early as 1784. It chartered a number of companies to carry out the projects, but decades passed with little being accomplished. In 1819 the state established a Board for Internal Improvements to solve its transportation problems. North Carolina produce was finding its markets largely in neighboring states. Most of the trade of the Roanoke Valley made its way to Norfolk, and much of the trade of the central part of the state flowed southward into South Carolina. North Carolinians hoped that if these leakages were checked a commercial city would grow up on their own coast equal in importance to Philadelphia, Baltimore, or Charleston. To this end the state subscribed to stock in companies chartered to improve navigation on six rivers, build a canal between the Yadkin and Cape Fear rivers, and cut a short intracoastal waterway.

But results continued to fall far short of objectives. The construction of sluices on the Roanoke River and its Staunton and Dan tributaries, for which Virginia's subscriptions were larger than North Carolina's, secured small boat passage on the Staunton through the Blue Ridge Mountains to Salem, Virginia, and on the Dan to the foot of the Saura Town Mountains in North Carolina. Otherwise little progress was made, and most of the companies abandoned their efforts. The Board for Internal Improvements attributed the failure partly to blunders made “before the aid of science and skill had been enlisted to direct the operations” and partly to diffusion of effort among so many projects. Indeed, too much had been attempted with too little. Private investment had been meager, and total state expenditures to 1833 were less than $300,000.[7]

South Carolina expended much more money but fared little better. Beginning in 1799 a number of companies tried to make various rivers more navigable with slim finances and even slimmer results. Traffic in the state was still too light to create effective demands for expensive improvements, and cotton growers managed to get their crops to market profitably with rivers and roads as they were. Not until competition arose from western cotton producers after 1815 were South Carolina planters spurred to lower the cost of marketing their crops through improved transportation facilities. The effort began in 1817 when South Carolina appointed a “Civil and Military Engineer," purchased a company that had attempted improvements on the Catawba and Wateree rivers, and subscribed heavily to the stock of the Winyaw and Wando Canal Company. The next year it appropriated $1 million for an ambitious program, to be spent at the rate of $250,000 a year.

In 1819 the state placed the work under the direction of a Board of Public Works but because of squabbles over the board’s management transferred authority to a Superintendent of Public

Works in 1822. By 1834 South Carolina had spent nearly $2 million, more than half of which went into costly canals bypassing falls in the center of the state; had improved to some extent nearly 2,000 miles of rivers, the most important work being done on the Wateree and the Great Peedee; and had constructed nearly 150 miles of roads. Yet the results were on the whole disappointing. Individual improvements had been selected on a highly political basis, thus frustrating the development of a coherent transportation system. Improvements above the fall line, including most of the canals, locks, and sluices, were not navigable by steamboats, and almost all were ultimately abandoned. Below the fall line, periodic flooding choked the channels with debris and sandbars, yet maintenance was neglected as disappointment over the failure of the system to meet expectations created a reluctance to spend more money on waterways. Finally, as with many inland navigation projects along the East Coast, by the time the system was completed the practicability of railroads was being demonstrated. As in North Carolina, the poor results were attributed in part to too much diffusion of effort. There was hardly a public work in the state, except the State Road and the Columbia Canal, declared a disillusioned governor, that "would find a purchaser . . . at a public auction."[8]

In Georgia reaction to the spread of the cotton culture westward after the War of 1812 paralleled that in South Carolina. Upland sections of the state demanded better means of transportation, and in 1817 Georgia made its first appropriations for river improvement. It allocated funds for each of the important streams in the state, to be expended by local commissioners, and established a fund of $250,000, later increased to $500,000, to earn interest for financing projects. Improvements came so slowly and were so disappointing when they did come that in 1825 the state established a Board of Public Works to inaugurate a more centralized and effective program. The next year, however, it abolished the board and went back to a policy of appropriations expended by local commissioners. By 1829, when efforts petered out, river navigation had been little improved.

The Savannah River, flowing to the state's principal port, was of special interest to many Georgians. Because it formed the state's boundary with South Carolina, improvement was considered a matter for joint action; but as Georgia was the most benefited, it put the most money into the river. In 1817 a steamboat company began running vessels on the Savannah to Augusta. Within a few years, however, despite work on the river's channel, traffic declined because of the inability of the boats to reach Augusta during long seasons of low water. At one time the legislature planned more extensive improvements to facilitate their passage but subsequently turned its attention

to a railroad line to Macon. Inhabitants of the Piedmont continued to demand improvements on the upper course of the Savannah, but rapid descents and frequent heavy freshets prohibited better navigability at reasonable cost. The farmers of the upper river had to wait for a railroad.[9]

EARLY HARBOR WORK

Harbor improvement in the early years of the Republic was minimal. Trade still remained highly dispersed among many small ports, and seagoing vessels, while adopting better hull designs and rigs, did not increase much in size from colonial times. Ships still rarely exceeded 400 tons displacement and 100 feet in length. As late as 1828 the largest ship in Salem's merchant fleet, which in the early nineteenth century experienced its golden age of world-wide commerce, was 404 tons.[10]

But not all ports had the depth of water or degree of protection shipping interests preferred. In 1784 the port wardens of Baltimore tried to deepen the harbor using a Dutch-type mud mill, a dredging machine that raised spoil with long-handled scoops operated by man-powered treadmills. Dredging is said to have been attempted on the Thames River channel to Norwich, Connecticut, in 1785, on the Hudson River shoals between Albany and Troy in 1799, and on the Delaware River mud at New Castle Harbor in 1803 and after. In 1804 Oliver Evans of Philadelphia built a steam-powered dredging machine equipped with wheels for travel on land and a paddle wheel for propulsion on water, but the extent of its use is uncertain. In 1785 Pennsylvania, in an early effort to furnish protection to shipping, constructed timber piers at Marcus Hook on the Delaware River to provide a harbor of refuge from drifting ice.[11]

Beginning in 1790 several states carried out harbor improvements under the authority of congressional enabling acts. Congress granted permission to levy tonnage duties on shipping to Georgia to pay for raising wrecks sunk during the Revolutionary War to block Savannah Harbor, to Maryland to support improvements by the port wardens of Baltimore, and to Rhode Island to subsidize work at Providence by a “River Machine Company" incorporated for that purpose. In 1798 Congress approved the incorporation of a company by Massachusetts to erect a pier at the mouth of the Kennebunk River in Maine to protect the channel. In 1806 it allowed Pennsylvania to levy tonnage duties at Philadelphia for “building piers in, and otherwise improving the navigation of the river Delaware, "[12] with which monies, apparently, the state constructed ice harbors of refuge at Chester and Fort Mifflin.

Harbor improvements by the federal government's own agencies developed slowly. The First Congress of the United States had provided that all expenses for the maintenance and repair of

lighthouses, beacons, buoys, and public piers should be defrayed out of the Treasury of the United States and that all contracts for work be made by the Secretary of the Treasury with the approval of the President.[13] Under this authority relating to navigation safety, the federal government undertook its first harbor projects. In 1802 a congressional directive to the Treasury resulted in the construction of cribwork piers at New Castle, Delaware, to provide vessels a harbor of refuge from the dangerous Delaware River ice. In 1820-1821 the Treasury built a pair of cribwork piers at the entrance of the Kennebunk River to confine the channel and obtain more water over the bar. In 1822 Congress authorized the Treasury to construct a breakwater to improve a harbor of refuge at the Isles of Shoals, about seven miles off Portsmouth, New Hampshire, and to erect two piers at Cape Henlopen, at the mouth of Delaware Bay, to create a refuge from the twin threats of storms and ice. Calling on other government agencies in 1823 for projects other than piers, Congress authorized a collector of customs to supervise the removal of a channel obstruction between the harbors of Gloucester and Annisquam on Cape Ann in Massachusetts and ordered a survey by an Army Engineer to determine how best to improve the entrance of the harbor of Presque Isle, Pennsylvania, on Lake Erie.[14]

FOUR DECADES OF SPORADIC FEDERAL ACTIVITY

Even before the Presque Isle assignment to plan harbor work, the Army Engineers had planned river improvements. Under military appropriations bills of 1819 and 1820 they had made surveys on the Ohio and Mississippi rivers and several tributaries to devise methods for making them more navigable. In June 1823 the Engineer Department ordered the Board of Engineers to design the piers at Cape Henlopen that Congress had authorized the Treasury to construct the year before.

Responsibility for carrying out navigation improvements soon followed. On 24 May 1824 Congress provided for the removal, by *'engineers in the public service," of snags and sandbars from the Ohio and Mississippi rivers, work which President Monroe assigned to the Corps of Engineers. Two days later Congress voted appropriations for improving the harbor of Presque Isle and for repairing Plymouth Beach, Massachusetts, which sheltered the town's harbor. Further appropriations in the next two years provided for breakwater construction at two Lake Erie ports, for breakwater surveys at the Massachusetts harbors of Marblehead and Holmes* (Woods) Hole and a canal route survey across Florida, and for clearing obstructions from the Savannah River.[15]

On 20 May 1826 Congress enacted its first omnibus rivers and harbors bill, a measure that provided for more than 20 works and surveys on the Atlantic and Gulf coasts and on the Great Lakes.

Annually thereafter through 1838 Congress passed similar bills authorizing new projects and surveys or appropriating additional funds for projects under construction. With the exception of the act of 1836, few new projects or surveys were authorized after 1830, and appropriations were mostly for completing or continuing works. Occasional--y Congress also made individual appropriations for projects.

Much of the work on the East Coast was to protect shipping from storms or ice at both commercial harbors and harbors of refuge. At Plymouth, Provincetown, and Duxbury, Massachusetts, the Army Engineers by various means firmed beaches that formed natural harbor breakwaters to arrest water and wind erosion. They constructed granite seawalls on islands and headlands at Boston Harbor and at Black Rock and Westport harbors in Connecticut to preserve these natural harbor screens. At Little Egg Harbor, New Jersey, they strung jetties out from the shore of Tuckers Island, which protected the harbor, to prevent abrasion of the island by surf. At harbors without sufficient natural cover, the Engineers constructed rubblestone breakwaters, thus providing protected anchorages at Belfast and Portland, Maine; Rockport, Bass River, and Hyannis, Massachusetts; Churchs Cove, Rhode Island; and Stonington, Connecticut. At Cape Henlopen they took over the construction of the artificial harbor of refuge originally assigned to the Treasury; and on the Delaware River they constructed ice-breaker piers at New Castle and repaired those at Chester, Port Penn, Marcus Hook, and Fort Mifflin. They also built an ice breaker at Staten Island, New York, to protect the public wharf and buildings of the harbor's quarantine station.

Deepening channels to coastal or river ports constituted the bulk of other projects. Bars obstructing harbor entrances were tackled with horse or steam-powered dredging machines at Nantucket, Massachusetts; Bridgeport, Connecticut; Wilmington, Delaware; Baltimore, Maryland; and Brunswick, Georgia. For the benefit of shipping to Philadelphia, the Delaware River ice harbors of New Castle, Chester, Marcus Hook, and Port Penn were dredged; and for the benefit of shipping to Hartford and other river towns, dredging was begun on Saybrook Bar at the mouth of the Connecticut River. In the shallow Pamlico Sound area of North Carolina, dredging was performed to clear a shoal in the Pamlico River below the town of Washington, to remove shoals near the Ocracoke Inlet to the sound, and to open a navigable passage through adjoining Core Sound to Beaufort Harbor. In the Savannah River wrecks sunk during the Revolutionary War were raised and the shoals formed by them dredged. Rocks and other obstructions were cleared from the Kennebec River of Maine to facilitate navigation to Bangor, from the Saugatuck River of Connecticut to improve the harbor of Westport, and from the

Raritan River of New Jersey to benefit New Brunswick. In work aimed at protecting channels, a breakwater and dike were constructed at Southport, Connecticut, to confine the channel and prevent sand from washing into it; and at Edgartown, Massachusetts, a pier supporting a lighthouse was extended, also to prevent sand from being carried by littoral current into the harbor.

Several attempts were made to deepen channels by constricting river currents to increase their natural scour. The jetties at the mouth of the Kennebunk River, erected earlier by the Treasury and soon wrecked by storms, were rebuilt and extended; and new jetties were constructed at the mouth of the Merrimack River, at the entrance of the Saco River of Maine, and in the Cape Fear River below Wilmington, North Carolina. To improve the channel of the Thames River to Norwich, Connecticut, a number of wing dams were extended into the stream, the scouring effect of which was supplemented by dredging. Wing dams, together with shore-protection dikes and revetments as well as dredging, were also employed in the Hudson River to control the shoals above and below Albany.

The focus of the early East Coast projects was on harbors accessible to seagoing ships. Work on inland waterways was negligible. Rocks and shoals were removed from the Cocheco and Berwick branches of the Piscataqua River to permit small boats to reach communities a few miles upstream, the inside navigation channel between St. Johns River in Florida and St. Marys Harbor in Georgia was improved, and shoals were dredged in Joyces Creek at the southern end of the Dismal Swamp Canal. [17]

Early navigation projects on western rivers and on the Great Lakes followed the advance of the steamboat on these waters. But the steamboat was of little significance to improvements on the Atlantic seaboard. By the 1820s steamboat routes had been established on a number of rivers, bays, and sounds, but the instances of correlation between these routes and the localities of the river and harbor improvements are few and it would be difficult to credit these to the steamboat.[19] Even more than the sailing vessel, the coastal steamer, with its flat-bottomed hull, only slightly protruding keel, and gingerly dipping paddle wheels, was suited to shallow waters. The eastern steamer was primarily a passenger vessel--its large engines and huge stores of firewood (anthracite did not come in to general use until the 1840s) left little room for freight. And oceangoing steam vessels scarcely existed. Because of various technical and economic obstacles much harder to overcome than those met on sheltered waterways, the application of steam to ocean transportation was slow to develop. Not until the 1850s did either the coastal or ocean steam vessel begin to compete with sailing ships in the carrying trade.[20]

Navigation improvements on the East Coast coincided with a marked increase in coastal shipping. Although for some years after the War of 1812 foreign trade made little progress beyond prewar levels, the American fleet engaged in the coastwise trade grew steadily from 475,666 gross tons in 1815 to 842,906 gross tons in 1828, an increase that reflected' the rise of manufacturing in the United States and the more extended division of labor resulting from it. The acquisition of Florida in 1821 and an ever-increasing volume of goods from the South and West moving down the Mississippi, a considerable part of which went to northeastern ports, further augmented the coastal trade.[21]

Most of the projects had beneficial results. Some, however, were left unfinished, and almost all subsequently suffered from lack of maintenance, for no further appropriations were forthcoming until 1852. Just as it had been politically impossible for the federal government to initiate a unified national system of roads and canals, it was unable to institute a coherent plan for rivers and harbors improvement. Local and sectional pressures supported by logrolling tactics had produced rivers and harbors bills that appropriated small amounts for numerous projects in uncoordinated piecemeal fashion. Criticism and opposition arose both within Congress and in the executive branch. Except for the briefly incumbent Whig Presidents Zachary Taylor and Millard Fillmore, all chief executives to the time of the Civil War took the constitutional position that Congress could appropriate for works of a national character but not for projects of a local nature, a distinction often difficult to determine. They generally refused to present estimates for work to Congress and several times vetoed rivers and harbors bills. This was a period of turbulent party politics, and party alignment on the issue was clearly evident. The Democrats, who generally believed that the government should let economic activities pretty much alone, tended to be hostile toward internal improvements, while the Whigs, who held a broader conception of the powers and duties of the federal government, usually supported them. The Depression opening in 1837 and increasing state and sectional tensions did nothing to ease the controversy.

Except for a measure in 1844 confined to projects in the interior, there was not another general rivers and harbors act until 1852. Congress continued to make a few appropriations through special acts or riders attached to other bills. Projects on the East Coast, however, were restricted to minor works justified by military requirements. The Corps of Engineers cut a small canal in Florida between Mosquito Lagoon and the Indian River at a portage called the Haulover to permit easier movement of Army supplies in campaigns against the Seminole Indians, and it constructed or repaired seawalls at Boston Harbor and St. Augustine, Florida, to preserve sites for fortifications.[23]

The Rivers and Harbors Act of 30 August 1852 was the product of election-year tactics. In the campaign of that year the Whig and Free Soil parties, both more attuned to the interests of eastern businessmen and western farmers than the southern-controlled Democratic party, proclaimed themselves in favor of internal improvements. Swaying with the political winds, Congress appropriated in excess of $2 million for more than 100 works and surveys, 46 of which, at a cost of about $640,000, were on the East Coast. With the Whig Millard Fillmore in the White House, the bill was assured of presidential approval.[24]

More than half of the East Coast projects consisted of repairing or continuing works left untouched for over a dozen years. Combating the depredations of storms and time, the Corps of Engineers repaired the breakwaters at Portland and Hyannis, the jetties at Kennebunk River, and the ice piers at Chester and New Castle; they patched up a seawall at Marblehead and a dike at Woods Hole built years before by other agencies; and they closed several large breaches in the beach at Plymouth opened by a gale in 1851. Continuing unfinished projects, the Corps worked on the Delaware Bay breakwaters and the Boston and St. Augustine seawalls, resumed beach protection measures at Provincetown, and again dredged and made other channel improvements at Bridgeport Harbor and in the Hudson, Pamlico, Savannah, and Cape Fear rivers.

Undertaking new projects, the Army Engineers constructed breakwaters at Owls Head and Richmond Island harbors in Maine and ice-breaker piers at Reedy Island in the Delaware River. They blasted out rocks at New Haven Harbor, Connecticut, at Cobscook Bay, Maine, and at Hell Gate in New York's East River. They dredged at Charleston and Providence harbors, in Newark Bay, in the Kennebec, James, Appomattox, and Patapsco rivers, and at the mouths of the Susquehanna and St. Johns rivers. They also made an unsuccessful attempt to reopen navigation between Albemarle Sound and the Atlantic Ocean at Nags Head on the Outer Banks of North Carolina.[25]

The act of 1852 failed to restore an ongoing program of navigation improvement. The Democrats won the election, and with the party opposed to internal improvements in power for the rest of the decade, Congress did not pass another general rivers and harbors bill until after the Civil War. Through special acts it authorized four works in the interior and three in the East, and passed five of these bills over the vetoes of President Pierce. The three eastern projects allowed the Corps to continue work on the Savannah and Cape Fear rivers and to deepen the Patapsco River to make Baltimore Harbor accessible to steam frigates and other vessels of the United States Navy.[26] When these appropriations and those of 1852 ran out, river and harbor improvement by the federal government again came to a halt, with many projects still uncompleted.

PRESSURES FOR NAVIGATION IMPROVEMENTS

At the close of the Civil War several forces converged to settle the long-debated issue of river and harbor improvement. Many Atlantic harbors were feeling the pinch of three decades of economic and technological development that had drastically changed long-existing patterns of maritime activity. Between 1830 and 1860 world shipping had expanded enormously as part of the complex development labeled the Industrial Revolution. Manufacturing had increased immensely and had tended to become geographically concentrated, necessitating the transportation of raw materials from remote places and the mass shipping of finished products to distant markets. The construction of railroads, canals, river works, and highways had greatly increased the hinterlands of seaports and provided cargoes for ships on a scale formerly unknown. The tonnage of United States ships engaged in all employments rose from 1.19 million tons in 1830 to 5.35 million in 1860. In this same period the annual tonnage of American vessels that entered and cleared from American ports increased nearly sixfold.

The growing volume of trade, the concentration of overseas commerce at major ports, the rise of packet lines operating on definite routes and regular schedules, and the increasing carriage of bulky products led to a demand for larger vessels. In 1830 a ship of more than 400 tons was considered a monster. In the early forties ships of 1,000 tons were regarded as very large. By the fifties ships of this size were the typical deep-sea freighters and many vessels registered 1,500 or more tons. These developments affected not only the rising primary transshipment centers of New York, Boston, Philadelphia, and Baltimore, but also smaller harbors all along the seaboard as schooners and an increasing number of steamers carried an expanding amount of commerce between the larger and smaller ports.[27]

During the same years that Atlantic harbors were experiencing unprecedented use, people of the interior were organizing great commercial conventions calling for the improvement of the Mississippi and Ohio rivers and their tributaries. Among the earliest was a meeting in Memphis in 1845. From then on powerful associational appeals for waterway projects came steadily from the South and West. Reinforcing the resolutions of these conventions was an outpouring of tracts on river improvement that by 1860 had become a considerable body of literature. Even the war did not retard the movement. In 1863 a call signed by 14 senators and 80 representatives in Congress brought 2,000 delegates to a waterway convention in Chicago to demand improvements on the Erie Canal and on canals in Illinois and Michigan. The next year another convention in Louisville urged improvement on the Ohio River.[28]

These developments and appeals elicited from the nation's capital a response very different from that of the prewar decades. The Civil War opened a period of amazing growth in transportation, trade, industry, and agriculture that dwarfed even the substantial advances of earlier years. Old political patterns dissolved before new dynamic forces, and new ruling groups emerged anxious to provide expanding enterprise with a federal helping hand. And this assistance included the development of the nation's navigable waterways. The Republican party had begun its national career with a declaration in its platform of 1856 that appropriations by Congress for the improvement of rivers and harbors were constitutional and justified by the obligation of the government to protect the lives and property of its citizens. The Democratic party, forsaking its earlier opposition to internal improvements, was no less eager to give river and harbor improvement steady and generous support.[25]

RIVER AND HARBOR PROJECTS EXPAND, 1866-1914

River and harbor work resumed in a small way even before the war ended. In June 1864 Congress authorized the Secretary of War to expend $350,000 to repair harbors on the seaboard and Great Lakes. Improvements on a broad scale began in June 1866 with a congressional appropriation of nearly $3.7 million for more than 50 works and nearly 40 examinations and surveys throughout the country. Thereafter river and harbor expenditures grew by large amounts. For the decade of the 1870s they totaled nearly $54 million; for the decade ending in 1914 they came to more than $325 million.[30]

This extensive program embraced more than 500 waterways on the Atlantic seaboard. The Corps of Engineers dredged harbors to provide deeper and wider channels, anchorages, and turning basins; improved channels through inlets, bays, sounds, and offshore thoroughfares; cleared rivers of obstructions to small craft navigation; and created sheltered passages along the coast by cutting inland waterways. Many projects included structural works: breakwaters to improve natural harbors and to build wholly artificial harbors of refuge; jetties to stabilize harbor and river channels, control tidal currents, form ice harbors, check shifting sands, and protect shores from erosion; and dikes, walls, revetments, and other structures to preserve harbor and river shorelines.

As the program of navigation improvement expanded, work at major harbors tried to keep pace with constantly increasing commerce and larger ships. Steam was replacing sail and iron was replacing wood. By using iron, vessels could be built of far greater size than previously had been possible. Trans-Atlantic express liners increased in size from less than 4,000 tons in the 1860s to 12,000 tons in the 1890s and to 48,000 or more tons by 1914.[31]

New York Harbor, with a controlling depth over its outer bar and several inner shoals of almost 24 feet at mean low water, had been the envy of other Atlantic ports. But by the 1880s large ships on trans-Atlantic runs could cross the bar only on flood tides. The first improvement project, begun in 1886 and completed in 1891, provided a passage 30 feet deep and 1,000 feet wide through the Main Ship and Gedney channels to deep water outside the bar. Within a few years the channel was again inadequate, and in 1899 Congress authorized the construction of a 40-foot-deep, 2,000-foot-wide channel. To avoid interrupting the busy traffic of the port, the outer bar was dredged at the East, renamed Ambrose, Channel, a hitherto shallow and little-used passage that now became the main entrance channel to the harbor. As the dredging equipment then existing in the United States was incapable of doing such deep work while exposed to the open sea, the contractor was allowed a year to build two dredges before beginning the project. Before the unprecedented job was completed in 1914, however, the Corps built four dredges of its own for the project and transferred a fifth from the Delaware River. Commenting on the commerce of the port, the New York Engineer District noted that the value of foreign exports and imports (the District did not provide statistics for coastwise commerce) for the year 1914 was $2.1 billion, an increase over the valuation for 1886 before improvement began of $1.3 billion. Costing less than two-thirds of 1 percent of the increase in the annual value of foreign commerce, the projects were excellent investments.[32]

At Boston Harbor the original improvement project, adopted in 1867, enlarged the main ship channel from 18 feet deep and 100 feet wide at its most restricted point to 23 feet deep and 600 feet wide. A project of 1892 extended the depth to 27 feet and the width to 1,000 feet, and a project of 1899 increased these dimensions to 30 and 1,200 feet. Three years later Congress authorized another enlargement of the channel to 35 feet deep and between 1,200 and 1,500 feet wide.[33]

Shipping to Philadelphia originally had to contend with ten or more bars scattered down the Delaware River between the city and Delaware Bay that restricted channel depths at mean low water to between 17 and 20 feet. Initial improvements consisted of sporadic dredging and rock removal under separate appropriations. The first systematic and permanent improvement began in 1885 when a special Corps of Engineers board studied navigation of the river as a whole and recommended the construction of a ship channel to Philadelphia at least 600 feet wide and 26 feet deep. This work was carried out at some bars and shoals by the federal government and at others by the city of Philadelphia. Hitherto, vessels of deep draft had been compelled to ride two high tides to ascend the river to Philadelphia; now they could make the whole trip on a single tide. Continued dependence on tides,

however, was not satisfactory for long, and in 1899 Congress authorized the construction of a 30-foot channel. Work was nearing completion in 1910 when a new project increased the channel depth to 35 feet and the width to between 800 and 1,200 feet. 34

The controlling depth of the Patapsco River channel to Baltimore Harbor was originally 17 feet at low tide and only slightly more than 18 feet at high tide. Vessels exceeding that draft were obliged to transfer portions of their cargoes to lighters about 14 miles from the city in order to ride high enough to reach the wharves. The improvement begun in 1853 aimed at a channel depth of 22 feet and a width of 150 feet. Post-Civil War projects adopted in 1871, 1881, and 1896 deepened the channel by stages to 30 feet and widened it to 600 feet. In 1905 Congress authorized a 35-foot channel between 600 and 1,000 feet wide.[35]

Norfolk Harbor had a deep-water entrance on Hampton Roads, but several shoals within the Elizabeth River restricted mean low-water depths of the main and branch channels to 21 feet or less. The original project adopted in 1876 provided for dredging the worst shoals only. Modified no less than eight times between 1885 and 1910, the project ultimately provided a main channel 35 feet deep and at least 400 feet wide from Hampton Roads to a point above the Norfolk Navy Yard on the South Branch of the Elizabeth River.[36]

Efforts at other harbors to keep abreast of commercial and technological developments were equally striking. At Wilmington, North Carolina, the pre-Civil War projects to increase the governing low-water depths of the entrance bar and the channel of shallow Cape Fear River beyond 7.5 feet had accomplished little. Between 1870 and 1890 five successive projects, which included closing inlets between islands at the mouth of the river as well as dredging, gradually increased the channel's dimensions to the city to 20 feet deep and 270 feet wide. The rivers and harbors acts of 1910 and 1911 provided for securing such depths in excess of 20 feet as the appropriations would allow. The act of 1912 authorized a 26-foot channel 300 feet wide to the sea and 400 feet wide across the bar. 37 At Savannah, three projects adopted between 1873 and 1902 deepened the river channel to 28 feet at mean high water. A project begun in 1910 established a channel depth of 26 feet at mean low water. At Charleston, the deepest channel across the entrance bar was originally about 12 feet. In 1878 Congress authorized the construction of two jetties and auxiliary dredging to obtain a channel of not less than 21 feet, A project of 1899, which was modified in 1910, provided for dredging the entrance channel to 26 feet and then to 28 feet.[38]

An exceptionally dogged race to accommodate increasing commerce and larger ships took place at Providence, Rhode Island. The Providence River, which stretches eight miles from the city to Narragansett Bay, was obstructed by several shoals that at one point opposite the city decreased the low-water depth of the channel to 4.5 feet. At mean low water the channel in the portion of the river forming the harbor ranged from 4.5 to 15 feet deep, but most of the river at this point was only 1 to 3 feet deep. Resuming after the Civil War work begun in 1852, the Corps of Engineers had by 1870, under three successive projects, cleared the channel to a controlling depth of 14 feet. In 1878 they began constructing a channel that was 23 feet deep and 150 wide in the center to accommodate large ocean steamers. At lesser depths it was more than 1,000 feet wide to give sailing coasters more room to maneuver. Four years later Congress modified the project to provide a 25-foot-deep, 300-foot-wide steamer channel to deep water in Narragansett Bay and a capacious anchorage basin at Providence. In 1896 Congress authorized a 25-foot-deep, 400-foot-wide channel that would follow a more direct route to the ocean through the West Passage of Narragansett Bay. Projects of 1902, 1907, and 1910 provided for enlarged anchorage areas. The project of 1910 also authorized increasing the dimensions of the channel to 30 feet deep and 600 feet wide.[39]

Far outnumbering the projects at major harbors were works at smaller rivers and harbors to establish channel depths ranging from 4 to 16 or more feet at mean low water. As railroads did not reach every locality and their unregulated rates in any event encouraged waterway competition, and as highway transport was still limited, small streams continued throughout the nineteenth century to offer a mode of transportation for many inland communities. Small harbors all along the coast were even more vital to the economy. As shelters for fishing fleets and processing points for catches, they were elements of a large and still-growing industry. As commercial ports they *were* more active than ever, for as the commercial life of the nation quickened it was still mainly coastal vessels that moved bulk trade along the Atlantic seaboard.

Trunk-line railroads, having in the main followed economic development westward across the continent, provided long-distance east-west connections with the major Atlantic ports. But through lines going north and south developed at a slower pace. Rivers and estuaries had to be crossed by immense bridges; the diverse gauges of southern railroads had to be changed to standard size; the provincial aims of short lines had to be harmonized with the objectives of longer hauls; long-haul commerce had to be stimulated by low rates and efficient service; and the consolidation of short lines had to take place to bring about these changes

and to form effective through routes. These changes came later than on east-west routes and were not fully apparent until the close of the century. Even then the railroads, afflicted by freight congestion and a car shortage that reached critical proportions within a few years, were far from able to meet transportation demands. Some roads would accept only the high-value freight that was more profitable to carry. Thus coastal trade continued to move many of the bulky commodities that had always been its mainstay.[40]

Fishery products, lumber, lime, building stone, ice, flour, grains, cotton, rice, tobacco, naval stores, manufactures, and many other goods found their way up or down the seaboard by water. Topping the list of bulk carriage was the coal trade out of Norfolk, Newport News, Baltimore, Perth Amboy, and New York. The use of coal for heating buildings in the North and for powering industry all along the seaboard increased tremendously in the last three decades of the nineteenth century. Small two-roasted schooners and brigs that entered all of the little ports of the coast at first monopolized this trade. Competition soon followed from a new breed of three- to six-roasted schooners of much greater tonnage that carried coal and other goods to the larger and deeper ports. But smaller vessels continued to service the lesser ports all along the coast, and every town and industrial enterprise located on waters navigable by the shallow-draft schooners had its coal wharf.

While sailing vessels continued to hold their own and something more in the coastal trade, steamships were by 1900 coming into increasing use, particularly in the coal and lumber business. After about 1880 tow barges were also frequently seen along the seaboard. The feasibility of regular towing over long distances had finally caught on, and tugs, no longer merely harbor and river auxiliaries, had become seagoing power plants. Tow barges had the flexibility of freight cars. They could be detached at ports along the route, unloaded, and then picked up on a later voyage. By 1900 barges and tugs, although bringing in less tonnage than ships, formed one-half of the arrivals in Boston Harbor.[41]

FLUCTUATIONS IN IMPROVEMENTS IN THE TWENTIETH CENTURY

By 1914 river and harbor improvement on the East Coast began to taper off as fewer projects were authorized. With the outbreak of war in Europe in 1914 a drive for governmental economy contributed further to the decline. Until 1919, when Congress authorized 27 new projects on the Atlantic seaboard, mostly of minor nature, rivers and harbors bills confined appropriations with only few exceptions to maintenance and to works already under way. 42 The downtrend was graphically illustrated in New

England, whose heavily indented coastline abounds in small harbors. In 1900 66 coastal navigation projects were under construction --as many as were under construction throughout all the United States and its territories in 1979. By 1917 projects had been completed on 95 rivers and harbors. On 68 of these waterways no further improvements have been made; on the other 27 nothing more was done until after World War 11. Improvements on 38 waterways were continued or renewed between the World Wars, but projects were begun at only seven new localities.[43]

As projects became fewer they became more restricted to localities of major commercial importance. Shipping at many small ports declined as trains and trucks took over business from coastal vessels. From 1920 through 1929 Congress authorized only 48 projects or modifications of existing projects for the Atlantic seaboard. Expenditures, including monies for maintenance as well as improvement, averaged $10.4 million a year. The total national outlay on rivers and harbors, excluding specialized expenditures such as those under the Mississippi River and California Debris commissions, averaged about $42.7 million a year, or about 6 percent more than expenditures for 1914.[44] Since prewar costs had inflated 105 percent by 1920, outlays for general navigation improvements were actually reduced by half.

The depression years of the 1930s restored for a decade an extensive program of navigation improvements. Expenditures for fiscal year 1930 were about 30 percent greater than for fiscal year 1929. The increase, the annual report of the Chief of Engineers explained, was “due to a speeding up of operations to meet the demands of expanding commerce, and in a considerable degree to carry out the purposeful plan of the administration to alleviate conditions of unemployment.” Not only had the greater ports benefited, the report noted, but also numerous lesser harbors and waterways had been improved and maintained. Between 1930 and 1938 larger regular appropriations together with public works and emergency relief programs increased general river and harbor expenditures nationwide to an annual average of more than $115 million. Expenditures on the Atlantic seaboard, while not increasing in proportion to the national average, nevertheless rose to more than $19 million a year, and four rivers and harbors acts between 1930 and 1938 authorized 265 works of improvement.[46]

World War II, burdening the Corps of Engineers with increased military responsibilities and creating a critical shortage of construction equipment, materials, and manpower, restricted river and harbor work to projects directly related to defense. On the Atlantic coast projects focused on improving facilities for naval and supply vessels. These works, several of which were already in progress, included clearing a 27-foot

channel in the Kennebec River to the Iron Works at Bath where warships were constructed for the Navy; dredging a 40-foot channel in the Delaware River to the Philadelphia Navy Yard; dredging to 35 feet the main channel of Charleston Harbor leading to the Navy Yard and the Army Terminals on Cooper River; deepening the Ambrose Channel to New York Harbor to 45 feet and dredging additional anchorage space within the harbor; improving the extensively used New York and New Jersey Channels, which pass through Raritan and Newark bays, for the benefit of large oil tankers; and removing from the main ship channel of Portland Harbor a rock ledge hindering the operation of deep-draft vessels. Submarine attacks off the Atlantic coast prompted additional emergency measures. The Corps stabilized bank sections on the recently completed Chesapeake and Delaware Ship Canal and with Navy Department funds constructed the three-mile Cape May Canal from Cape May Harbor to Delaware Bay.[47] Both improvements provided greater protection for shipments of freight and oil.

Congressional authorization between 1945 and 1950 of 198 projects on the Atlantic seaboard promised a strong revival of navigation improvements.[48] Only a fraction of the projects had been started, however, when hostilities erupted in Korea. Military requirements again took priority, a huge Cold War defense building program was quickly cranked into operation, and river and harbor work shrank once more to a handful of essential projects. Through fiscal year 1955 navigation works on the East Coast numbered fewer than a dozen.[49]

Although the Cold War construction program continued without letup for nearly a decade, river and harbor improvement resumed on a sizable scale in fiscal year 1956 when the number of projects under construction on the East Coast jumped from 6 to 38. The next year 37 projects were initiated. Thereafter the volume of work gradually diminished. From 1958 to 1967 between 7 and 14 projects were initiated each year; from 1968 to 1979 between 1 and 6 were initiated; and in fiscal year 1980 none was started. The number of projects under construction each year ranged from 39 in 1958 to 13 in 1980.[50]

During the post-World War II period more than 250 works of improvement were carried out at nearly as many localities. Small harbors and lesser ports necessarily accounted for most of the projects. Many are primarily fishing ports or seafood processing centers. Others are commercial ports handling a variety of bulky freight, including petroleum products, coal, fertilizers, chemicals, agriculture products, aggregates, pulpwood, metals, lumber, cement, limestone, machinery, and numerous other commodities including large quantities of fish and shellfish. Reflecting a new public interest, many small harbors are used heavily and

others almost exclusively by pleasure craft. Work on scores of these small waterways was carried out under Section 107 of the Rivers and Harbors Act of 1960, which permits the Corps to construct certain small projects not specifically authorized by Congress when they will result in substantial benefit to navigation.[51]

At major ports, the Corps of Engineers developed channels, anchorages, and turning basins to accommodate deep-draft oil tankers and other large vessels. They deepened the main channels at Portland, New York, Norfolk, and Newport News to 45 feet and those of 22 other ports to between 35 and 42 feet. In the past 25 years, commerce at these ports increased markedly. At New Haven, Norfolk, and Charleston the tonnage of freight moved in 1979 was approximately double that moved in 1954, and at Portsmouth, Fall River, New London, Wilmington (N.C.), Savannah, and Jacksonville it was approximately three times greater. At Port Everglades it was about five times greater, and at Morehead City it was seven times greater. The ports with the greatest tonnage in 1979 were New York (163.6 million), Philadelphia (54.8 million), Baltimore (51.4 million), Norfolk (48.6 million), and Boston (26.3 million).

In 1979 26 ports had freight traffic exceeding two million tons. Petroleum products or crude oil dominated the list of commodities handled at most of them. The exceptions were Baltimore, Norfolk, and Newport News, where the leading commodity was coal; Morehead City, where it was liquid sulphur; and Hempstead (N.Y.), where it was aggregates. Foreign traffic was present at all the ports except Hempstead, a small six-foot-deep harbor on Long Island Sound that is one of the nation's leading ports handling sand, gravel, and crushed rock. Foreign tonnage exceeded domestic tonnage at Portland, Portsmouth, Philadelphia, Wilmington (Del.), Baltimore, Norfolk, Newport News, Savannah, and Miami, but was concentrated in greatest quantity at New York (56.2 million), Baltimore (37.5 million), Norfolk (37.2 million), and Philadelphia (34.5 million).[52]